Ontario Geological Survey

Northern Ontario
Engineering Geology Terrain Study 20

RAT PORTAGE BAY AREA

(NTS 52E/NE and part of 52E/NW)

District of Kenora

Compliments of
ONTARIO
MINISTRY OF NORTHERN DEVELOPMENT
AND MINES

by

D.R. Hallett and M.A. Reed

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1980

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93-02306/

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THIS PROJECT WAS FUNDED BY
THE ONTARIO MINISTRY OF NORTHERN AFFAIRS
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ISSN 0709-4671
ISBN 0-7743-4296-X

Parts of this publication may be quoted if credit is given. It is recommended that reference to this report be made in the following form:

Hallett, D.R. and Roed, M.A.
1980: Rat Portage Bay Area (NTS 52E/NE and part of 52E/NW), District of Kenora; Ontario Geological Survey, Northern Ontario Engineering Geology Terrain Study 20, 13p. Accompanied by Maps 5055 and 5057, scale 1:100 000.

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CONTENTS

		Page
1.0	Introduction	1
2.0	Geologic Setting	2
	2.1 Bedrock Geology	2
	2.2 Quaternary Geology	3
	2.3 Physiography	4
3.0	Engineering Terrain Units	4
	3.1 Bedrock	7
	3.2 Ground Moraine	8
	3.3 Glaciofluvial	8
	3.4 Glaciolacustrine	9
	3.5 Alluvial	10
	3.6 Organic	11
4.0	Example of Derived Map. Sand and Gravel Resources	11
	4.1 Types of Derived Maps	11
	4.2 Sand and Gravel Resources Map	12
5.0	References	13

TABLE

1 – Summary of terrain unit characteristics and engineering significance 6

FIGURE

1 – Diagrammatic sketch showing typical terrain types and their representative letter symbols 5

MAPS
(accompanying report)

Map 5055 (coloured) – Northern Ontario Engineering Geology Terrain Study, Data Base Map, Rat Portage Bay (NTS 52E/NE and part of 52E/NW). Scale 1:100 000.

Map 5057 (coloured) – Northern Ontario Engineering Geology Terrain Study, Sand and Gravel Resources Map, Rat Portage Bay (NTS 52E/NE and part of 52E/NW). Scale 1:100 000.

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D.R. Hallett[1] and M.A. Roed[2]

1.0 INTRODUCTION:

This report and the accompanying map present the results of an engineering geology terrain study for the Rat Portage Bay area, District of Kenora. The area, which covers NTS block 52E/NE and part of 52E/NW, lies between Latitudes 49°30'N and 50°00'N and Longitudes 94°00'W and 95°10'W. The report and maps form part of a series of publications which provide similar terrain data for approximately 370 000 km^2 of northern Ontario.

The purpose of this study is to provide an inventory of engineering geology terrain conditions that will serve as a basic data framework for engineering and resource planning activities, at a level of detail consistent with a scale of 1:100 000. The terrain information is contained on the Data Base Map (OGS Map 5055, accompanying this report). The Sand

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Manuscript approved for publication by the Chief, Engineering and Terrain Geology Section, July 3, 1979. This report is published with the permission of E.G. Pye, Director, Ontario Geological Survey.

and Gravel Resources Map (OGS Map 5057, accompanying this report) is a derived map which illustrates the potential for finding surficial deposits of aggregate within the various terrain units.

Interpretation of 1974 black and white aerial photographs, at a scale of approximately 1:50 000, formed the basis of the terrain mapping process. The interpretation was compared to relevant published information for the study area. In addition, two automobile field trips were conducted in 1978, an early reconnaissance trip to identify major terrain units and a later one to verify the airphoto interpretation. Thus, the Data Base Map represents a reconnaissance overview of the engineering conditions of the terrain.

An engineering terrain legend was developed to facilitate the mapping and to provide a common information base for the entire map series. This legend is shown on the accompanying Data Base Map. Further discussion on the mapping techniques, legend format, and possible uses of this engineering geology information is available in the Ontario Engineering Geology Terrain Study Users' Manual (Gartner, Mollard, and Roed, in preparation), a companion publication to this series of maps and reports.

2.0 GEOLOGIC SETTING

The Rat Portage Bay Area is underlain by crystalline bedrock of Precambrian age. A discontinuous mantle of Quaternary surficial deposits overlies the bedrock.

Rugged rocky uplands and rocky lowlands dominate the area. Ground moraine occurs as a dominant unit to the east and southwest of Kenora, and as a patchy cover throughout the bedrock terrain. Glaciofluvial deposits, which are not widespread, generally occur in small, thin pockets. Numerous glaciolacustrine deposits occur in the lowlands north of Kenora. Organic terrain is limited to poorly drained depressions and alluvium occurs along many streams.

2.1 BEDROCK GEOLOGY

The Rat Portage Bay area straddles the Wabigoon Belt (mainly meta-

volcanics and metasediments) and the English River Gneiss Belt, both of which belong to the Superior Structural Province of the Canadian Shield. The southern half of the area is occupied by an east-trending belt of Early Precambrian mafic to felsic metavolcanics and lesser amounts of metasediments. The northern half and western part of the area are underlain by Early Precambrian felsic igneous and metamorphic rocks, mainly gneiss. Both the metavolcanics and the gneisses are intruded by mafic and ultramafic intrusive bodies, composed mainly of gabbro, norite, and diorite. Proterozoic (Keeweenawan) diabase dikes cut all other rock types; one of these exceeds 40 km in length. Several short north-northwest- and north-northeast-trending faults have been mapped (Davies and Pryslak 1967).

Major occurrences of gold, silver, copper, and molybdenum have been found in several parts of the metavolcanic metasedimentary belt; the entire belt possesses a high to medium mineral potential, particularly for these commodities. The gneissic rocks have low mineral potential (Springer 1978).

2.2 QUATERNARY GEOLOGY

Northwestern Ontario has been affected by several stages of glaciation during the Pleistocene. However, only the deposits of the last glaciation, the Laurentide of Wisconsinan age, are preserved in the Rat Portage Bay area. The ice began to advance approximately 100 000 years ago and travelled as far south as central Wisconsin before receding. The ice disappeared from the Rat Portage Bay area approximately 15 000 years ago (Prest 1970). Zoltai (1961) gives a more complete account of the glacial history of the region.

Widespread stagnation of the ice mass resulted in the deposition of a variety of surficial materials. Till was deposited directly by the ice in the form of ground moraine. In the rugged rocky uplands characteristic of the eastern part of the area, the glacier overdeepened valleys, rounded off bedrock outcrops, and left scattered patches of moraine and boulders. Meltwater from the glacier formed glaciofluvial outwash deposits, and accumulated in lowlands to form glacial lakes. These grew in size and coalesced to form an enormous body of water called Glacial Lake Agassiz. Deposits of glaciolacustrine silt and clay occur wherever this lake covered the land, especially north of Kenora. In some localities,

bedrock hills were swept clean of unconsolidated material during the high water stage of Glacial Lake Agassiz as evidenced by numerous bare bedrock knobs and ridges in lowlands and in the archipelago of Lake of the Woods. In other areas, the bedrock has been almost completely covered by the lake deposits.

The complete disappearance of glacial ice and the gradual draining or drying up of glacial lakes marked the end of the Pleistocene Stage of the Quaternary Period. Since that time, approximately 9 000 years ago (Prest 1970), modern streams have developed alluvial flood plains and organic deposits have accumulated in wet depressions. These deposits are nonglacial in origin and together with the various glacial materials, comprise the variety of Quaternary unconsolidated deposits that form a discontinuous mantle over the bedrock in the Rat Portage Bay area.

2.3 PHYSIOGRAPHY

Rugged bedrock uplands occur extensively in the northern and eastern parts of the area. Local relief is generally less than 60 m, but some rugged terrain with higher relief occurs around Hawk Lake near the eastern boundary of the area. The land close to Lake of the Woods and along the Winnipeg River north of Kenora is generally of low relief (less than 15 m). Elevations within the map area range from less than 315 m to approximately 450 m.

3.0 ENGINEERING TERRAIN UNITS

Engineering terrain units are composed of a combination of various materials (unconsolidated and/or bedrock) which form recognizable landforms with certain engineering characteristics. Major terrain unit groups, and the engineering significance of each, are discussed in detail. These include bedrock terrain (RN, RR), ground moraine (MG), glaciofluvial outwash (GO), and glaciolacustrine plains (LP). Organic terrain (OT) and alluvial plains (AP) also occur, but are not discussed in detail. A diagrammatic sketch of a typical terrain setting is given in Figure 1. Table 1 summarizes the characteristics and engineering significance of the major terrain units in the Rat Portage Bay area.

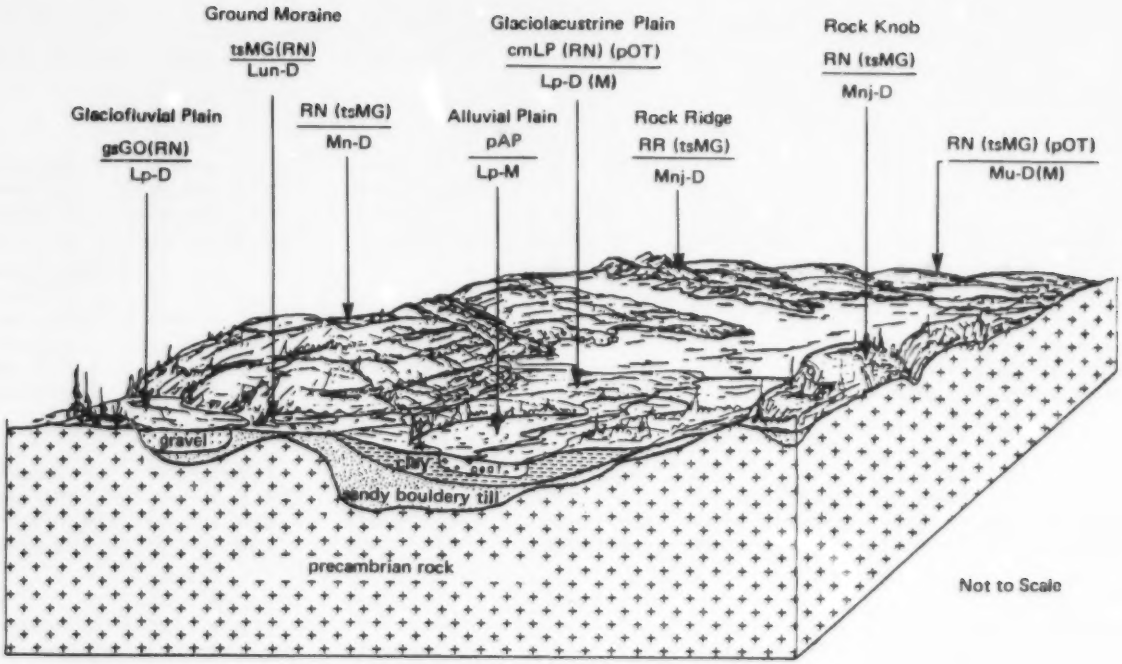

FIGURE 1 – DIAGRAMMATIC SKETCH SHOWING TYPICAL TERRAIN TYPES AND THEIR REPRESENTATIVE LETTER SYMBOLS.

TABLE 1 SUMMARY OF TERRAIN UNIT CHARACTERISTICS AND ENGINEERING SIGNIFICANCE, RAT PORTAGE BAY AREA

	CLASSIFICATION	ENGINEERING USE				
Terrain Unit and Location	**Material; Relief; Topography; Drainage**	**General Construction**	**Transportation Routes**	**Waste Disposal**	**Groundwater Supply**	**Major Constraints**
BEDROCK TERRAIN (RN), throughout the map-area	rocky; low to high relief; knobby, ridged, and rugged; good drainage	excavations and fill necessary in most places	extensive excavations and fill necessary	pollution potential is high	domestic supply available in most places from deep wells	blasting required for excavations; lack of aggregate
GROUND MORAINE (MG), east of Kenora around Silver Lake and Longbow Lake	till, sand, and boulders (tsb); moderate relief; good drainage	minor excavation and regrading necessary	excavation and fill in rugged terrain where deposits are thin; importation of aggregate for major roads	suitable for septic systems where deposit is at least 1.5 m thick	deposits are generally too thin; water supply obtained from underlying bedrock	deposits are thin and discontinuous
GLACIOFLUVIAL OUTWASH (GO), around the Kenora airport and as small deposits scattered throughout the area	sand and gravel (sg); low relief; planar to knobby; good drainage	desirable material properties for construction of all types	suitable aggregate material available	pollution potential is high	large yields possible where deposits are thick	deposits are small and rapidly diminishing
GLACIOLACUSTRINE PLAIN (LP), lower elevations north of Kenora	clay and silt (cm); low relief; planar to undulating; good drainage	suitable subgrade; low bearing capacity; frost susceptible	aggregate must be imported	suitable where water table is low	domestic supply is generally available from shallow large bore wells	slope instability, frost susceptibility; low bearing capacity for large structures; aggregate must be imported
ORGANIC TERRAIN (OT), in depressions throughout the bedrock terrain	peat (p); low relief; planar; poor drainage	high compressibility; low bearing capacity; frost susceptible	unsuitable subgrade except for minor light vehicle roads	high pollution potential	quantity and quality are low	low strength; high frost susceptibility; poor drainage

Comments: Some alluvial plains have been mapped (e.g. along the Whiteshell River) but most are too small to map at this scale.

3.1 BEDROCK

Examples: $\frac{\text{RN(tsMG)}}{\text{Mnj-D}}$ $\frac{\text{RR(pOT/cmLP)}}{\text{Lrj D(M)}}$

Bedrock terrain, which dominates the map-area, constitutes ground that is underlain by bedrock, either at surface or within 1 m of the surface. Most of this unit is rugged (j), knobby (n), of moderate relief (M), and well drained (D) except for wet organic depressions (W). A thin, discontinuous mantle of ground moraine composed of sandy till (tsMG) is widespread throughout the bedrock terrain, and glaciolacustrine deposits (LP) occur in places. Scarps and steep-sided gullies are characteristic features. The unit is especially rugged around Hawk Lake on the eastern boundary of the map-area.

Bedrock terrain in the southern part of the area, around Lake of the Woods, is of low relief (L) and varies in character from knobby (n) to ridged (r). Glaciolacustrine plain composed of clay and silt is the most widespread subordinate landform, but ground moraine (MG) and organic terrain (OT) also occur.

The principal engineering significance of bedrock terrain is that it is difficult and expensive to excavate. Blasting is required for all sub-surface excavations. Extensive cut-and-fill operations are required in rugged terrain for transportation route construction in order to eliminate extreme horizontal and vertical alignments. Many small sand and gravel deposits scattered throughout the terrain provide adequate material for minor access road construction. However, for major transportation routes, aggregate is often imported from considerable distances at high cost. Bedrock terrain does possess considerable potential for aggregate obtained in rock quarry operations. Quarries along the northern CN route at White Lake near the Manitoba border and along the CP route at Hawk Lake just outside the eastern boundary of the area provide coarse aggregate for railway construction and maintenance in the region.

Bedrock terrain is unsuitable for waste disposal except where a thick layer (at least 1.5 m) of associated soil material is present. Groundwater potential is generally low, except in fault zones where it may be possible to obtain substantial quantities of water.

3.2 GROUND MORAINE

Examples: $\frac{\text{tsMG(RN)(cmLP)}}{\text{Mun-D(M)}}$ $\frac{\text{tsMG/RR(RN)}}{\text{Mrnj-D}}$

Ground moraine (MG) composed of sandy till (ts) forms a thin, discontinuous mantle over the bedrock throughout much of the area. Till deposits up to 6 m in thickness occur in the ground moraine near Longbow Lake southeast of Kenora, along the Jones Road northeast of Kenora, and locally on the southern side of many bedrock knobs (RN) and ridges (RR). Only those deposits that are large in aereal extent and have a considerable thickness of till are mapped as predominantly ground moraine. Relief is generally moderate and the topography varies from undulating (u) to rugged (j) in character. Drainage conditions are most often dry (D).

The engineering significance of the sandy till in ground moraine is limited because of the thin, discontinuous nature of the deposits. General construction and transportation route alignment is somewhat easier and less expensive than in bedrock terrain, since slope conditions are not as rugged and aggregate material is more readily available. Only major highways will require importation of large quantities of aggregate.

Groundwater potential in the till is poor since the unit does not attain an adequate thickness over large areas. Where the till is at least 1.5 m thick, ground moraine is considered suitable for septic drain tile fields.

3.3 GLACIOFLUVIAL

Examples. $\frac{\text{sgGO(RN)(pOT)}}{\text{Lu-D(M)}}$ $\frac{\text{sgGO(tsMG)(RN)}}{\text{Ln-D}}$

Glaciofluvial outwash consisting of sand and gravel (sgGO) occurs throughout the area as small isolated patches in topographic lows. The surface of the terrain is generally low in relief and undulating (Lu), and drainage conditions are dry (D).

The largest glaciofluvial unit occurs around the airport east of Kenora and consists of sand and gravel. This deposit possesses the best potential

of any in the area for large quantities of aggregate. The quality is variable and sand is likely the dominant constituent. Other important deposits occur north of Lake of Two Mountains in Forgie Township, northeast of Longbow Lake near Kenora, and east of Blindfold Lake in le May Township.

The principal engineering significance of sand and gravel outwash is its potential for use as a high quality aggregate construction material. Transportation routes and general construction are easily carried out in or close to outwash due to the proximity of aggregate sources and the good foundation conditions.

Groundwater potential is generally poor because outwash deposits are relatively thin in this area and the water table is low. Where the water table is high, the groundwater potential would be excellent. The unit is not suitable as a medium for waste disposal since it is very permeable and the pollution potential is high. Detailed aggregate mapping and assessment is warranted in this map-area, especially around Kenora.

3.4 GLACIOLACUSTRINE

Examples: $\frac{\text{cmLP/RN(tsMG)}}{\text{Lup-D}}$ $\frac{\text{cmLP(RN)(sgGO)}}{\text{Lnp-D}}$

Glaciolacustrine deposits of calcareous silt and clay (cmLP), representative of deposition in Glacial Lake Agassiz II (Zoltai 1961), are widespread in areas of lower elevation north of Kenora. These fine-grained varved deposits are brown to grey in colour and form an undulating plain (Lpu) broken at higher elevations by rock knobs (RN). A reddish clay occurs south of Kenora in association with bedrock terrain. Ground moraine (MG) and glaciofluvial outwash (GO) also occur in places. The clay overlies glaciofluvial gravel and sand near Kenora, a situation which may be more common than indicated on the map. Glaciolacustrine deposits also occur as subordinate landforms in association with other major terrain units, except in the northeastern part of the map-area where elevations rise to 450 m. Drainage conditions are generally dry (D).

Transportation route construction and general near-surface construction are inexpensive in glaciolacustrine terrain because of the ease of excava-

tion. However, due to the high percentage of silt, these fine-grained deposits are frost susceptible. The bearing capacity of the underlying materials must be considered during the planning of large structures. Silt and clay are poor construction materials, so that importation of aggregate is often necessary.

The erosion potential of the fine-grained deposits is high and requires special attention at river crossings, along or near slopes, and on shorelines subject to wave action.

Although the moisture content of the silt and clay is high, groundwater potential is poor due to the low effective porosity and permeability of the unit. However, shallow, large bore wells should provide enough water for domestic use. Substantial buried-valley aquifers may occur below the glaciolacustrine unit in some places, but none were identified in this study. Because of the unit's effluent attenuation capabilities and low percolation rates, it is suitable for construction of septic systems and for near-surface waste disposal.

3.5 ALLUVIAL

Example: $\frac{\text{mpAP}}{\text{Lp-W}}$

Alluvial plains consisting primarily of silt and peat (mpAP) occur along most streams, but they are generally too small and poorly developed to map at the scale of 1:100 000.

Alluvial plains are unsuitable for most engineering uses due to poor drainage, a high water table, periodic flooding, and the poor bearing capacity of the silt and peat layers.

Groundwater potential is poor in most localities, since the fine-grained nature of most alluvium in this map-area limits production. Also, the presence of organic materials results in poor quality water. The unit is not suitable for waste disposal, since nearby streams could become polluted.

3.6 ORGANIC

Examples: $\frac{pOT}{Lp\text{-}W}$ $\frac{pOT/cmLP(RN)(sgGO)}{Lp\text{-}M}$

Organic terrain (OT) composed primarily of peat (p) occurs in small, isolated, poorly drained depressions in bedrock terrain, along streams, and near lakes. Drainage is mixed (M) to wet (W).

The unit overlies glaciolacustrine silt and clay (cmLP) in depressions and occurs in association with bedrock knobs (RN). Sand and gravel outwash (sgGO) occurs in places beneath organic material north of Shoal Lake in Ewart Township.

Construction is difficult and expensive in organic terrain due to the poor drainage conditions and the low strength, low bearing capacity, high compressibility, and extremely high frost susceptibility of the soil materials. Light vehicle roads can be successfully constructed across some of the dryer deposits.

Groundwater potential is low and the terrain is not suitable for waste disposal.

4.0 EXAMPLE OF DERIVED MAP: SAND AND GRAVEL RESOURCES

4.1 TYPES OF DERIVED MAPS

The Data Base Map (OGS Map 5055, accompanying this report) forms a basic framework of resource characteristics that allows development of a wide variety of engineering or planning derivative maps. A derivative map can be defined as a graphic representation of the terrain in terms of its potential with respect to a specific engineering or planning use, or a number of uses. Derived maps are needed because many people who have special interests in the map-area may not have the necessary geological or engineering expertise to fully interpret the Data Base Map for their particular application. The objective of presenting such a map in this report, therefore, is to demonstrate how an easily understood illustration can be produced from the Data Base Map.

The derived map (OGS Map 5057) included in this report is a Sand and Gravel Resources Map which rates the terrain units of the Rat Portage Bay area with respect to potential for producing aggregate from the unconsolidated Quaternary deposits. Similarly, derivative maps can be developed which rate the terrain units for other important uses, such as groundwater potential, septic system suitability, solid waste disposal, general construction suitability, route assessment, and in some aspects of mineral exploration. It is also possible to prepare a derived map which would show those areas with little or no suitability for various types of development. Such a map would assist planners in avoiding hazardous lands.

4.2 SAND AND GRAVEL RESOURCES

The Sand and Gravel Resources Map (OGS Map 5057, accompanying this report) rates the various terrain units of the Rat Portage Bay area with respect to potential for surficial aggregate supply. The map shows six categories of varying potential for the production of aggregate. Much of the bedrock, glaciolacustrine, alluvial, and organic terrain units have only limited relative potential and are not included on the derivative map.

Each category (A through F) has been delineated according to the intrinsic or natural factors associated with the type of terrain under examination. An effort was made in each case to express both quantity and quality considerations, and to evaluate each area as a unique entity, rather than simply rank each terrain unit from 'highest potential' to 'lowest potential'. This method allows the user of the map to weigh the factor most important for his particular purpose, and removes some of the subjectivity involved when the ranking of resources is attempted. Aggregate resources are not plentiful in the Rat Portage Bay area. Most sand and gravel deposits are glaciofluvial in origin and are limited both in areal extent and in depth. Also, the quality of the deposits is variable and sand is the dominant constituent in many places.

Detailed airphoto interpretation and field investigations are necessary to accurately assess the quality and quantity of deposits with good potential. It is important to treat the information presented in this section only as a guide. Deposits must be further investigated prior to any decision regarding development.

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